

Figure 4.62 – Bag-in/bag-out filter housing

4.5 SIDE-ACCESS HOUSINGS

4.5.1 GUIDANCE FOR DESIGN OF SIDE-ACCESS HOUSINGS

The recommended capacity range for side-access housings are 2 filters (24- by 24- by 11.5-in.) per stage to 12 filters per stage (4 across x 3 high). Single filter units are also available. Units may be stacked 3 high if platforms are provided.

Housings may be provided with or without bag-in/bag-out features (**FIGURES 4.62 and 4.74**). Bag-in/bag-out side-access housings feature a ribbed bagging ring inside the side-access door. A specially designed polyvinyl chloride change-out bag is secured around the bagging ring after initial filter loading. All subsequent filter changes are accomplished through change-out bags. Contaminants are isolated to the inside of the bag to protect site personnel and permit safe

handling and disposal of spent filters. A self-adjusting filter seal mechanism prevents filter bypass and maintains a positive seal during normal system operation (**FIGURE 4.75**). The housing can also be utilized without the use of change-out bags, which may be specified where future hazardous contaminants are unknown.



Figure 4.63 – Incinerator exhaust filter



Figure 4.64



Figure 4.65



Figure 4.66



Figure 4.67



Figure 4.68



Figure 4.69



Figure 4.70



Figure 4.71



Figure 4.72



Figure 4.73 – Side-access housing with bag-in/bag-out covers



Figure 4.74 – Side-access housing with moisture separator



Figure 4.75 – Side-access housing with test manifold

4.5.2 RECOMMENDED DESIGN FEATURES

The following is a list of recommended housing design features.

Housing Material

- Standard 14-gage 304 stainless steel

Unit Construction

- All pressure boundary joints and seams seal-welded
- Surfaces free of burrs and sharp edges
- Reinforced to withstand up to 30 in.wg

Access Door

- Completely hand-removable
- Handles retained in access door after removal
- Protected door gasket seal covers entire inner door surface

Bagging Ring

- Two continuous ribs for optimum bag-seal
- Ring depth designed to contain bag during operations
- Smooth outer surface and hammed outer edge

Filter Clamping Mechanism

- Spring-loaded pressure bars exert uniform clamping force on filter frame.
- Spring-loading compensated for any loss of filter gasket memory
- Positive displacement screw-drive clamping mechanism
- Leaktight connection for clamping mechanism on outside of housing
- Series 300 stainless steel clamping mechanism construction
- Over 1/2-in. travel to prevent filter binding

Filter to Housing Seal

- Standard full perimeter flat mounting frame mates to filter gasket.

- Full seal weld around filter frame

Filter Removal Rod

- Standard mechanical assist on all multiple wide housings
- Operated through bagging ring

Pressure Taps

- Welded in housing, upstream and downstream of filter
- 1/2-in. National Pipe Thread half-coupling with plug

Seals and gaskets should be installed on doors, and a “knife-edge” gasket sealing surface should be provided. The gasket should be installed in as few pieces as possible to minimize the number of joints. The gasket should be designed to prevent leakage due to misfitting butt joints. Side-access, bag-out access doors often use gaskets that accommodate the door to the housing seals. Latches or bolts must be of sufficient quantity and strength to compress the gasket and ensure that the housing leakage criteria are met. Doors must allow access for testing and component inspection. The drawings for each type and size door should be submitted to the owner for review before fabrication. Door drawings should show the location and details concerning the hinges, latching lugs, and gaskets.

The number of normally open drains should be kept to a minimum. Drain lines must be valved, sealed, trapped, or otherwise protected to prevent an adverse condition where (1) air bypass can occur around filtration components, and (2) cooling/heating coil capacity is negatively impacted.

Traps or loop seals, when used, should be designed for the maximum operating (static) pressure the housing may experience during system startup, normal operation system transients, or system shutdown. Provision should be made for manual or automatic fill systems to ensure the water loop seals do not evaporate. If manual filling is utilized, a periodic inspection or filling procedure should be implemented. Use of a sight glass should be

considered to aid inspection. The same applies if a local sump is included in the design.

The drain system should be designed so that liquids do not back up into the housing. Hydraulic calculations should be prepared by the manufacturer to document this drain system feature to treat maximum coincident flow rate. Initial testing of the drain system should be performed by the owner on site after installation to demonstrate operability. When shutoff valves or check valves are utilized, they should be initially tested for operability and leakage on site, after installation, and periodically thereafter.

Basic Differences Between Nuclear Filtration Systems and Commercial/Industrial Filtration Systems

- The standard design pressure for nuclear systems is 10 to 15 in.wg. versus 3 in.wg or less for commercial/industrial. In addition, containment systems can be built to higher pressures, such as 30 to 40 in.wg without significant cost increases.
- Nuclear systems are designed, manufactured, and tested to a higher level of quality assurance such as ASME NQA-1.⁸ This QA includes certified welders, in-process inspections, material traceability, and several factory tests are standard, such as: filter fit, operability of filter locking mechanisms, flatness of filter sealing surfaces or alignment of knife edges, leak testing of each filter sealing surface and overall pressure boundary of each housing and/or system. Test reports are available to the customer for their files.
- Nuclear systems are designed and built with all-weld construction. All pressure-boundary welds are continuously welded. These systems are built for long life and RTV silastic sealants are not trusted over long periods of time.
- Over the last two decades, stainless steel has become a standard material of construction for containment systems versus galvanized construction for commercial/industrial systems.

- Most nuclear systems incorporate the bag-in/bag-out feature which allows the user to protect their maintenance personnel and the surrounding environment during filter change-out. Some applications don't require the bag-in/bag-out feature, but still require all the other features of containment, that make for a dependable, long lasting filtration system
- Nuclear filter housings incorporate filter locking mechanisms that are designed to achieve a filter-to-frame seal that will last throughout the life of the filter, not just when the filter gasket is new.
- Nuclear systems are designed so that each tier of filters has it's own access door. This is absolutely necessary when the bag-in/bag-out feature is required, but it is a desirable feature even without the bag-in/bag-out feature.
- Nuclear systems offer optional in-place test sections that allow in-place testing (i.e., validation) of installed systems. This testing can be for overall penetration or for in-place "scan" testing.
- Nuclear systems offer optional separate access doors for prefilters, which allows the seal of the HEPA filters to be on the upstream side.
- Most nuclear filter housings have "filter removal rods" to assist in pulling the second or third filter to the change-out position.
- Nuclear systems now incorporate isolation dampers in many cases. These dampers are now readily available in both "bubble-tight" and "low-leakage" designs. These dampers are designed, manufactured, and tested in the same manner as the filter housings.

Why Stainless Steel instead of Heavy Carbon Steel Construction?

- Nuclear filtration systems are usually constructed of 14- and 11-gage stainless steel and reinforced externally. The cost of this design is very nearly the same as manufacturing from heavy steel plates and priming/painting for corrosion protection.

- Stainless steel offers much better corrosion protection during installation and use, than painted steel.
- Decontamination and cleaning of systems is much easier with stainless steel.
- Modification of systems in the field is much easier with stainless steel. Changes, including welding, can be made without ruining the corrosion protection of the system.
- Stainless steel systems typically weigh less than the carbon steel systems.

4.5.3 SIDE-ACCESS HOUSINGS FOR CIRCULAR HEPA FILTERS

Side-access housings for circular filters have been designed for the installation of up to 12 plug-in, 2,000-cfm filters, although larger installations are possible, subject to operation conditions (FIGURES 4.76 through 4.78).



Figure 4.76 – Side-access housing circular HEPA design



Figure 4.77

The principal construction limitations of square filters are associated with geometry and gasket integrity in both manual and remote handling situations.

Gasket integrity has long been a problem in ensuring that the gasket provides a reliable seal after manual or remote installation.

The problem throughout is that the filter requires correct orientation. This is a major factor with manually located filters, but presents enormous problems when handled remotely because the filters require precise orientation and alignment with the seat on installation using power manipulators. Power manipulators have a low availability and require considerable maintenance.

The use of an internal lip seal offers the highest performance with the least force required. It is integral to the design and is extremely effective in negating alignment problems because it eliminates the remote handling restrictions of the square filters. Orientation is no longer a limitation, and the placing system can be a



Figure 4.78

- Normally, flow of air is from the inside of the insert to the outside, although reverse flow is possible.

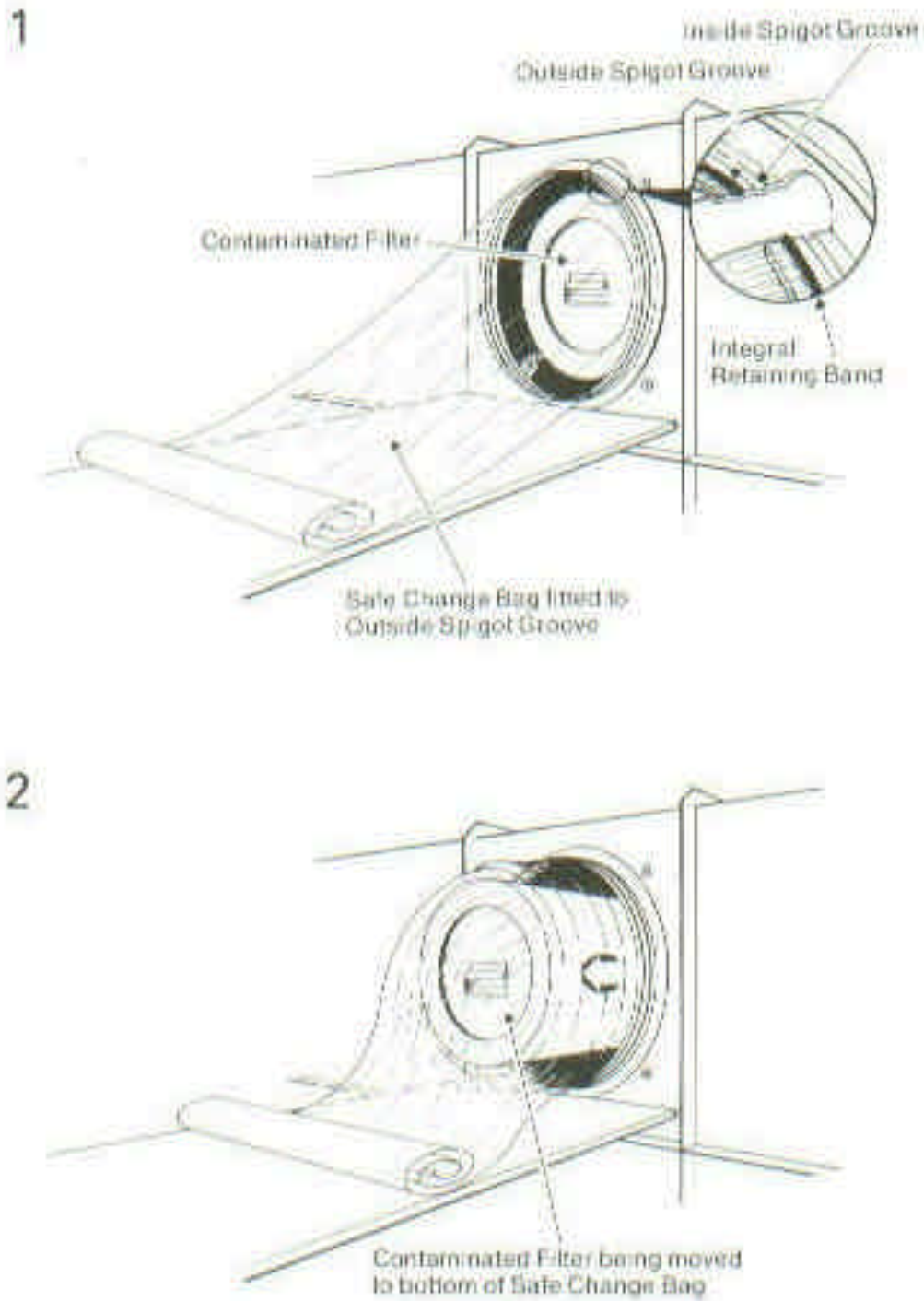


Figure 4.79

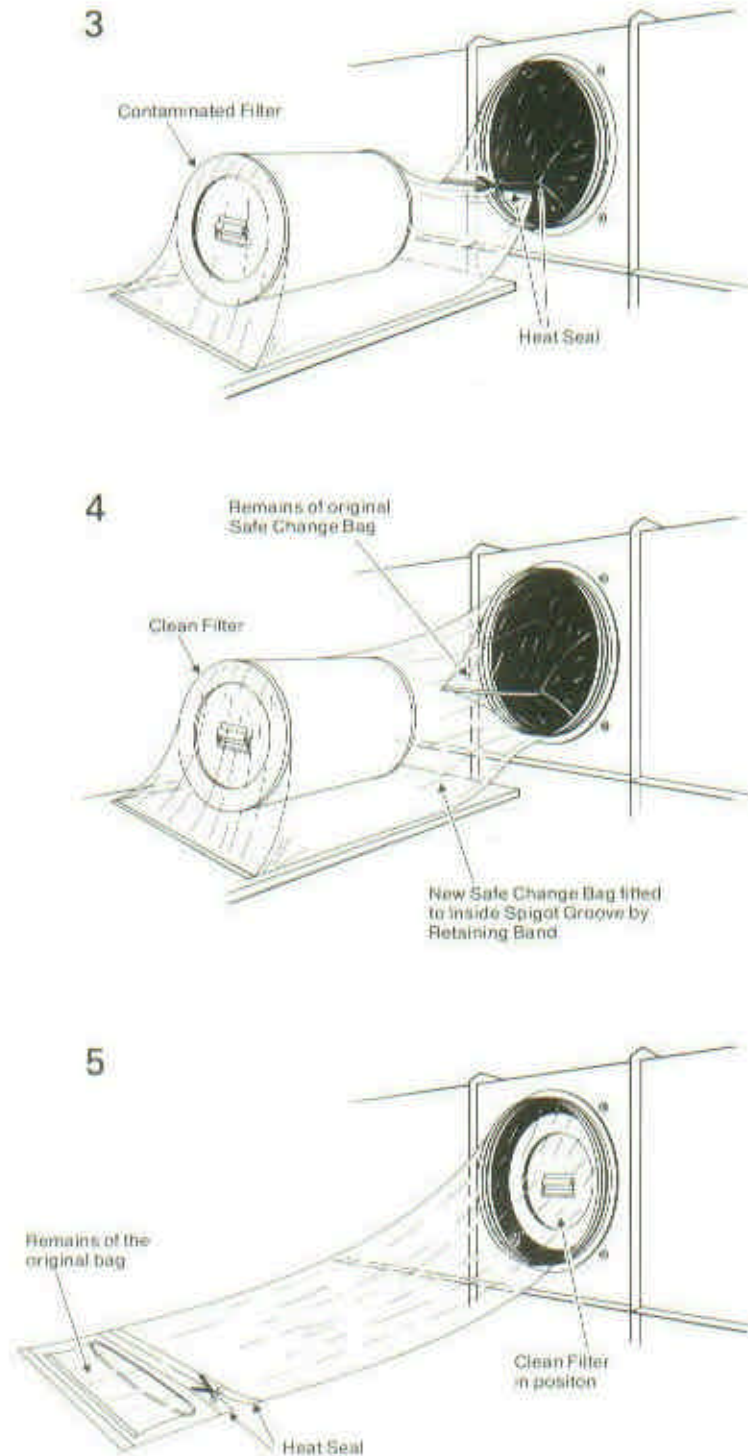


Figure 4.80



Figure 4.81

4.5.4 IN-PLACE TEST AEROSOL TEST

HEPA filter housings must be supplied with test sections on the upstream and downstream sides of the filter bank. Each test section must be isolated from the other to permit individual efficiency testing of each HEPA filter and its supporting framework in parallel and/or in series in compliance with ASME AG-1.²⁶

All filter testing must be conducted from a location outside the system using apparatus and devices that are supplied as an integral part of the test sections, including mixing devices and sample ports. The upstream and downstream test chambers contain mixing devices to mix and disperse a uniform challenge air/aerosol ahead of the filter and the effluent from the filter being tested. Challenge aerosol inlet ports and upstream and downstream sample ports must be provided for each HEPA filter. All mixing devices in the air stream must be designed to swing aside when testing has been completed.

The manufacturer must submit evidence that he has proof-tested his in-place test method according to the requirements of ASME AG-1²⁶ for systems containing two filters in series and two filters in parallel, with one leaking filter in each bank.

4.6 REFERENCES

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